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# Is Nigeria Ready for Inflation Targeting?

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# Is Nigeria Ready for Inflation Targeting?

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*Shehu Usman Rano Aliyu<sup>1</sup> and Abwaku Englama<sup>2</sup>*

## *Abstract*

*This paper evaluates whether Nigeria is ready to adopt inflation targeting (IT), a monetary policy framework that several emerging markets have adopted over the last one decade. The paper reviews literature on selected conditions for successful implementation of IT and then focuses on whether one specific precondition of an empirically stable monetary transmission mechanism is tenable. Vector autoregressive (VAR) model was applied using select monetary policy and other macroeconomic variables to explore the various channels using the Granger causality tests, impulse responses, and variance decompositions. Results show that inflation in Nigeria is impassive to monetary transmission variables in the model. Specifically, weak link between prices and credit and interest rate channels were established. However, evidence of strong inverse link between exchange rate and prices was found in the model. This suggests exchange rate pass-through on the level of prices in the economy. The paper, therefore, recommends the pursuance of IT lite in Nigeria.*

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*Keywords: Inflation targeting, vector autoregressive model, Granger causality test, monetary transmission mechanism, exchange rate pass-through.*

## 1.1 Introduction

Since early 1990's inflation targeting (IT) has been increasingly viewed as a good monetary policy framework and was widely acclaimed by economist and policymakers alike. Because of its enormous potentials as an effective instrument of managing inflation, nations that have adopted it never turn back. Inflation targeting is a monetary policy regime, which is characterized by public announcement of official target ranges or quantitative targets for price level increases and by explicit acknowledgement that low inflation is the most crucial long-run objective of the monetary authorities. According to Savensson (1999) IT framework sets out very clear goals for monetary policy, defines responsibilities, and establishes measures of accountability and transparency. It is however, characterized as '*constrained discretion*' because it requires the central bank to not only set out clear targets, but to use appropriate instruments to hit the target, Fischer (2000). Loayza and Soto (2002) observe that although the term inflation targeting is now commonly used by bankers and scholars, several features of this monetary

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regime and its effects on economic performance remain elusive. After experiencing moderate, but, persistent inflation rates for more than two decades, industrialized economies have controlled and maintained inflation at historically low levels in recent years. Evidences have shown that Inflation targeting frameworks have often been adopted in even economies without a history of stable inflation; this is particularly so for countries of Latin America and Africa who were seen as epitome of chronically high inflation. For instance, Chile and Brazil had inflation rate of 26 percent and 19 percent, respectively, prior to IT adoption and they have had a success story on inflation targeting.

Since the early 1990s, inflation targeting (IT) has become a popular choice of monetary policy regime, with more than 20 countries - both developed and emerging market economies that now adhere to IT framework. Evidences have shown that countries adopted IT under many different circumstances, ranging from a well-planned switch from a different policy regime (New Zealand, Canada) to the solution of a currency crisis (United Kingdom). Equally IT has been pursued with different vigor and under different sets of institutional arrangements - see Bamidele, 2007; for a detailed review of cross country experiences and prerequisites for successful IT in both developed and emerging economies. Nonetheless, the prerequisites include but are not limited to: independence of the central bank; absence of fiscal dominance, that is, where a Central Bank bears minimal burden of financing government deficit; a single, well-defined inflation target; a high degree of transparency and accountability of the Central Bank; a good inflation forecasting model; sufficiently virile financial markets in terms of both depth and breadth to be able to absorb the placement of both public and private debt instruments; etc.

This paper will not assess the merits and demerits of IT as this has been extensively discussed in previous studies: See, for example, Debelle (1997), Masson, Savastano, and Sharma (1997), Tutar (2002) and Truman (2003). It has, however, been observed by Bakradze and Billmeier (2007) that the growing number of countries that target inflation and the perceived success of this monetary policy strategy serve as a stimulus for countries that engage in alternative regimes - such as monetary or exchange rate targeting - to shift to IT or to consider more seriously, such a shift in the near future. Consequently, this consideration raises the question of how to evaluate whether a country is ready to join the group of inflation targeters now, later or even never.

Considerations for IT framework in Nigeria started since 2000 with the presentation of a position paper on the subject in the Bank; Uchendu, 2000. In furtherance to this, the Bank devoted its fifteenth annual conference to the theme “*Inflation Targeting in Nigeria*” in 2006. Similarly, with the enactment of the 2007 Central Bank of Nigeria (CBN) Act, operational autonomy of the CBN was strengthened. The Bank was charged with the responsibility of achieving price stability among other functions and the appointment and removal of the CBN Governor is subject to the confirmation of the Senate as enshrined in the Act. Uchendu (2007) further noted that the launching of the Financial System Strategy (FSS) 2020, added vigor towards implementation of IT framework in the country since it hinges on strategic objective of achieving low single digit inflation. The Bank on its part decomposed its Research and Statistics Department into a department each with a view to strengthen and improve the quality of data and research output carried out in different aspects of monetary policy implementation. Recently, modeling unit in the Research department is charged with the task of developing a robust model for Nigeria. To date, there is sufficiently large body of literature on lessons deduced for Nigeria on IT.

While these positive developments take place, it is imperative to assess, from empirical standpoint, whether Nigeria is ready for IT or not. A number of empirical studies have come up with different conclusions on the level of preparedness of different countries on adoption of IT framework. Weak Central Bank accountability and high financial instability, for instance, were the main concern in Chile’s bid to IT according to Mishkin (2000); Central Bank independence in South Africa according to Jonsson (1999) and Bakradze and Billmeier (2007) hammered on the need for Georgia’s Central Bank to overcome some institutional and operational weaknesses before it implements IT. South Africa is ready for IT according to Woglom (2000) and Poland according to Christofferson, Solk and Wescott (2001). Against this background, the main aim of this paper is to assess whether Nigeria is ready for the implementation of inflation targeting. It, therefore, seeks to estimate the quantitative relationship between inflation, monetary policy instruments and output. The paper extends the analysis further by exploring the nature of some monetary transmission channels. Empirical data from 1986Q1 to 2006Q4 would be sourced from publications of the Central Bank of Nigeria.

The main indicators are; Consumer price index, gross domestic product, money supply ( $M_2$ ), interest rate, exchange rate, fiscal balance, ratio of credit to money supply, treasury bills rate and lending rate

The rest of the paper is organized as follows: following this introduction is literature review and theoretical issues in section two. Central Bank independence, transparency and accountability and recent developments in monetary policy implementation are reviewed in section three while section four presents the research methodology of the paper. Results and discussions come up in section five and conclusions and recommendations in section six.

## II. Literature Review and Theoretical Issues

The need for stable prices in an economy has since been documented in both theoretical and empirical literature. This is because of the adverse effect of inflation on the economy – price distortion, flourishing of rent-seeking activities, misallocation of scarce resources and social unrest. The negative effect of inflation on economic growth has been explored in many studies see, for example, Barro (1995), Bruno and Easterly (1995) and Ghosh and Phillips (1998). According to Krueger (2005) inflation distorts resource allocation in the economy. It hurts the poorest members of society disproportionately. It creates uncertainty and it arbitrarily redistributes income and wealth. It undermines macroeconomic stability and it makes sustained rapid growth impossible to achieve. The choice of inflation targeting as instrument of macroeconomic management is increasingly gaining grounds since the pioneering example by New Zealand and Chile.

To date, over 20 countries, both developed and emerging economies have switched to this strategy and their performance is remarkable. According to Loayza and Soto (2002) except for two countries that became part of the European Monetary Union (Finland and Spain), no inflation-targeting country has ever abandoned the regime. What then exactly is inflation targeting? Although definitions differ in detail, there is some consensus on the main characteristics of this monetary regime: the existence of an explicit quantitative goal that engages the central bank in the primary objective of price stability; the lack of fiscal dominance and the absence of competing nominal objectives; and a monetary institution that enjoys instrument independence and operates transparently and openly to the public.

The following definition by Mishkin (2000) of inflation targeting captures most of the issues raised in the literature.

“Inflation targeting is a monetary policy strategy that encompasses five main elements: i) the public announcement of medium term numerical target for inflation; ii) an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated; iii) an information inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; iv) increased transparency of the monetary policy strategy through communication with the public and the markets about the plans, objectives and decisions of the monetary authorities; v) increased accountability of the Central Bank for attaining its inflation objectives”.

Although in practice no two countries or their central banks implement or have identical IT framework, yet a combination of the above elements have characterized the implantation of IT in most countries. Some central banks, for example the Reserve Bank of Australia, have a dual mandate combining price stability with full employment. In addition, for some central banks, the target (or sequence of targets) is a point, and for others it is a range, some define time horizon over which the target is to be achieved while some do not, etc., Truman and Janeiro (2002).

In the case of a point target, for instance, the central bank essentially by construction will not hit the target every month, quarter or year, but a miss of a certain size triggers a reporting and review process; this sounds more demanding on the side of the bank. Where the framework on the other hand involves a range, it does not specify time frame over which inflation is expected to return to the range. Although this omission may be viewed as a defect of the particular country's regime it, however, reduces the rigor of the regime, adding a further element of discretion.

The main goal of inflation targeting is the attainment of low level of inflation. This paves way for macroeconomic stability, wipe away uncertainty and promote long term contracts. Seyfried and Bremmer (2003) stated that the goal of inflation targeting is not on containing current inflation, but on intermediate and long term goal. As such, Central Banks according to Bernanke and Mishkin (1997) should pay close attention to indicators that have predictive power of future inflation. Pui (2003) cautions that inflation targeting in its pure sense (where output and economic growth are given no weights) is not likely to maximize social welfare since the contraction or expansion of the economy does not matter so long as the inflation target is met

Evaluating the success of IT countries, Mishkin and Posen (1997) discovered that IT has been highly successful in helping countries ..... to maintain low inflation rates and that there is no evidence that IT has produced undesirable effects on the real economy in the long run; instead it has likely had the effect of improving the climate for economic growth. Recent evidences have shown that the negative effect of high and variable inflation on macroeconomic stability, economic growth and income distribution largely outweigh the potential benefits derived from financing fiscal deficits through monetization. That it is no longer fashionable to hold onto the age-long growth-inflation substitution hypothesis propounded by A.W. Phillips<sup>3</sup>. Furthermore, Bamidele (2007) showed that most of the countries on IT framework have been able to simultaneously achieve a reduction in inflation as well as increase in output.

Notwithstanding the above success stories, a number of baseline studies have investigated both the theoretical and empirical basis for implementing IT as a monetary policy regime from varied perspectives; conditions for successful implementation of IT, reasons why countries switch to IT regime, who sets the inflation targets, constructing and evaluating competitive empirical models, etc. While Masson, Savastano & Sharma (1997) for instance, argued that the requirements of IT in most developing countries are absent due to seigniorage or due to lack of consensus on attaining low inflation as a primary objective; due to lack of powerful models which could enable successful inflation forecast according to Kadioglu, Ozdemir & Yilmaz (2000); or because of relatively weak central banks' accountability and high financial sector instability caused by flexible exchange rate according to Morande and Schmidt-Herbel (1999) and Mishkin (2000). However, this concern was examined critically by Reyes (2004) and his conclusion was that several studies have shown that over the past five to ten years the pass-through effect from currency depreciation into inflation has been decreasing in emerging economies that adopted inflation targeting during the mid and late nineties.

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<sup>3</sup> According to Sterne (2004) the growth-inflation substitution hypothesis has not prevailed on the average for the countries that have adopted inflation targeting. For example, in the U.K, inflation reduced from 3.7 percent in pre-inflation targeting regime to 2.2 percent during the inflation targeting period while the real GDP recorded a growth from 1.2 percent to 1.4 percent. In New Zealand, in the same period, there was a reduction in inflation from 7.5 percent to 2.7 percent while GDP grew from 0.2 percent to 2.4 percent.

Since the main focus of the paper is on the assessment of applicability of IT in Nigeria, more attention is devoted to review of literature in the area<sup>4</sup>. Studies on appraisal of conditions for adoption of IT in a number of countries reveal mixed outcomes. Although these studies were undertaken at various stages; for some countries it was before IT was implemented, and while for other, well after years of its implementation. A review of them, therefore, will provide some insights into the practical requirements, in terms of which set of particular variables matter for a successful implementation of the framework in Nigeria. The following is a review of some of them:

In South Africa, for instance, Jonsson (1999) examines the implications and relative merits and demerits of IT and concludes that although the country has satisfied the main prerequisites of inflation targeting; independence of central bank, none reliance to macroeconomic objectives which might be in conflict with low inflation, and relatively developed capital and money markets. However, what is needed is a refinement of the inflation forecasting framework and further experience with the operational aspects of the IT. Afterwards Woglom (2000) provides empirical evidences using VAR specifications that South Africa is a good candidate for inflation targeting. He further adds that the regime of flexible exchange rate which prevailed in South Africa provides automatic stabilization of IS shocks

Hazirolan (1999) assesses the applicability of the inflation targeting regime in the Turkish economy and gives a proposal for its implementation. However, Tutar (2002) discovers that disinflation should be Turkey's major priority. Her findings suggest that inflation seems to have a very strong inertial nature that might be caused by high expectation, relative price adjustments or institutional arrangements and direct linkage between monetary policy instruments and inflation do not appear to be strong, stable and predictable.

Using a VAR model, Gottschalk and Moore (2001) assessed the link between monetary policy instruments and inflation in Poland. Their result showed that although exchange rate was found to be effective with respect to output and prices, direct linkage between interest rate and inflation

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<sup>4</sup> See: Loayza & Soto, eds. (2002) "*Inflation Targeting: Design, Performance, Challenges*", Santiago, Chile, Central Bank of Chile for a detailed overview on Inflation Targeting



do not appear to be very strong. Christofferson, Solk & Wescott (2001) found that Poland is ready for IT. Others include: Jacobson *et al.* (2001) investigated the empirical basis for inflation targeting in Sweden using a VAR framework; Thenuwara (1998) evaluates the feasibility of inflation targeting in Sri Lanka by exploring the causal relationships associated with the monetary transmission mechanisms; Hoffmaier (1999) uses the VAR model to calculate impulse responses to exogenous monetary policy in North Korea and Soikkeli (2002) assesses the institutional and technical design of IT framework in Norway, etc.

Recently, Bakradze and Billmeier (2007) examined the applicability of inflation targeting regime in Georgia using a baseline VAR model. Their finding was that Georgia is not yet ready to successfully implement IT because the National Bank of Georgia (NBG) suffers from some institutional weaknesses - e.g., a multiplicity of potentially conflicting goals - and de facto implementation sometimes falls short of the de jure institutional environment. Moreover, monetary policymaking in Georgia is hampered by the lack of a reliable indicator of the monetary stance - a short-term interest rate while monetary transmission mechanism highlights the importance of the exchange rate channel of transmission of monetary policy.

Bulir, *et al* (2008) using three key IT communication tools - inflation targets, inflation forecasts, and verbal assessments of inflation factors contained in quarterly inflation reports—provided a consistent message in five out of six countries; Chile, the Czech Republic, Hungary, Poland, Thailand, and Sweden. However, no single central bank, according to them, in the sample stands out as an exceptionally good forecaster of inflation and communicator of its policies.

Conceptually, IT describes a monetary policy framework in which central banks accept and announce certain targets of inflation, over a given period of time, as a measure of policy anchor and are accountable for deviations of actual from set targets. Three main forms of inflation targeting have been identified: (i) Full Fledge IT (FFIT), that is, when a country is ready to adopt IT as its single nominal anchor upon which macroeconomic stability would be achieved. This is suitable for countries with a robust or sound financial environment, and a central bank, which is transparent, accountable and highly committed to the attainment of the goals of IT. (ii) Eclectic IT (EIT) when a country, for instance, pursues IT along with other monetary policy objectives in a stable financial environment which, however, is less accountable and transparent. (iii) Inflation

Targeting Lite (ITL): Low profile form of IT pursued by countries, largely due to lack of strong or credible macroeconomic environment. ITL countries float their exchange rate and announce an inflation target, but are not able to maintain the inflation target as the foremost policy objective. Stone (2003) classified 19 emerging market countries as practitioners of ITL. Angeriz and Arestis (2007) argue that FFIT is not possible in ITL countries because: (a) Lack of a sufficiently strong fiscal position and high debt/GDP ratio. (b) Lack of a fully developed monetary and financial system. (c) Vulnerability to economic shocks (especially supply shocks) owing to their low degree of development. (d) Lack of transparency in the operation and implementation of monetary policy.

By extension and from the review factor militating against successful launching of FFITL are in other words necessary its take up. Myriad of these factors have been identified above. Here is a checklist of some of them.

- i) Central bank independence
- ii) Transparency and accountability
- iii) Sufficiently virile financial markets in terms of both depth and breadth
- iv) Single and well-defined inflation target
- v) Robust econometric model for forecasting inflation
- vi) Existence of stable and predictable relationship between monetary policy instruments and inflation.
- vii) Absence of fiscal dominance
- viii) Absence of multiple policy objectives
- ix) Institutional considerations
- x) Minimal burden on Central Bank financing of government deficit

### III. Central Bank Independence, Transparency and Accountability

One feature of an effective central bank is independence<sup>5</sup>; these include clear and precise mandate; authority and ability to take effective action to achieve its key objectives and effective

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<sup>5</sup> Sterne (2004) argues that although Central bank independence is a key component of numerous inflation targeting frameworks, but the literature, that describes central bank independence as a pre-condition for inflation targeting misses the point, since both inflation targets and independence are themselves part of a broader process of

mechanism to hold the central bank to account. In terms of clear and precise mandate, the 2007 CBN Act stated that one of the mandates of the Bank is that of achieving price stability. To achieve that the Bank has instrument autonomy and does not need to consult anybody or organization in the choice and use of its policy instruments for monetary management. Similarly, the Bank has financial autonomy and does not rely on the treasury for its operational expenses. In fact the 2007 Act vested the power to approve the budget of the Bank in the Board of Directors. To ensure the independence of the Bank the Governor can only be removed by the President provided that the removal shall be supported by two-thirds majority of the Senate praying that he be so removed.

The day-to-day activities of the CBN are quite transparent and truly accountable as enshrined the CBN Act. Information about the bank's activities is available on a daily basis on the bank's website. Besides, a wide range of monetary and financial data is published at regular intervals. Specifically, Section 35 of the 2007 CBN Act states: "*The Bank shall make public, at all times, its monetary policy rate*". The Bank has, in addition, powers to hold external reserves, conduct treasury operations, regulate credits in the economy and manage liquidity, all in pursuance of the core mandate of the Bank. A committee which is strategic in this regard is the monetary policy committee (MPC). It communicates its decisions to the public immediately after its meeting which whole bi-monthly. Section 12 Sub-sections (1) states the composition of the committee as follows:

"In order to facilitate the attainment of price stability and to support the economic policy of the Federal Government, there shall be a Committee of the Bank known as the Monetary Policy Committee (in this Act referred to as "the MPC") which shall consist of: a) the Governor of the Bank who shall be the Chairman b) the four Deputy Governors of the Bank c) two members of the Board of Directors of the Bank d) three members appointed by the President e) two members appointed by the Governor"

The conduct of Monetary Policy in Nigeria and all activities of the Central Bank of Nigeria relate with the core mandate of the bank as an apex institution. Therefore, in pursuance of its functions and in compliance its core mandate, the CBN undertakes monetary policy in order to:

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strengthening society's resolve to develop institutional arrangements that deliver low inflation. The UK experience from 1992 to 1997 demonstrated that – even without independence – inflation targeting could be a marked improvement on previous policy regimes, and this may have helped to encourage the decision to make the Bank of England independent in 1997.

- Maintain Nigeria's external reserves to safeguard the international value of the legal currency.
- Promote and maintenance of monetary stability and a sound and efficient financial system in Nigeria.
- Act as banker and financial adviser to the Federal Government; and
- Act as lender of last resort to banks.

Important to the attainment of a sound monetary policy is the identification of a reliable monetary transmission mechanism<sup>6</sup>, which best evokes monetary actions into desired target. Over the conduct of monetary policy in Nigeria has undergone significant changes. From the use of direct instruments of monetary controls during the pre-adjustment period up to 1986 to a shift towards an indirect approach anchored on the use of market based instruments in monetary management. The desire is to wipe away distortions and inefficiencies that had bedeviled the financial system caused by long years of use of administrative instruments of control. The aim is also to engender competition among the operators in the financial system and the entire economy.

Table 1 presents some monetary policy aggregates in the Nigerian economy between 1999 and 2007. For those variables that go in the same direction, high growth rate of  $M_2$  prompts high monetization of the economy and this causes high inflation. Impressively, however, inflation turned out to be in a single digit in 2006 and 2007 and this is a good outcome for IT. Exchange rate on the other hand depreciates, though not persistently.

Table 1: Monetary Policy Outcomes, 1999 – 2007

| Aggregate                  | 1999 | 2000  | 2001  | 2002  | 2003  | 2004  | 2005  | 2006  | 2007  |
|----------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| $M_2$ Money Growth         | 32.5 | 21.3  | 17.7  | 19.4  | 25.0  | 12.3  | 16.6  | 30.6  | 30.9  |
| CPI Inflation              | 6.6  | 6.9   | 18.9  | 12.9  | 23.8  | 10.0  | 11.6  | 8.5   | 6.6   |
| Fiscal Balance             | 29.7 | 15.5  | 21.7  | 18.8  | 15.4  | 11.5  | 8.4   | 4.9   | 4.8   |
| Exchange Rate              | 29.7 | 102.1 | 111.9 | 121.0 | 129.4 | 133.5 | 132.1 | 128.7 | 125.8 |
| <i>Memorandum Items</i>    |      |       |       |       |       |       |       |       |       |
| Real GDP growth            | 3.0  | 3.8   | 4.7   | 4.6   | 9.6   | 6.6   | 6.5   | 6.0   | 6.2   |
| Monetization ( $M_2$ /GDP) | 21.9 | 22.8  | 28.1  | 29.6  | 28.6  | 19.8  | 18.0  | 19.8  | 25.5  |
| Credit to the Economy/GDP  | 19.8 | 10.4  | 18.1  | 16.7  | 17.8  | 17.3  | 15.5  | 4.14  | 11.3  |

<sup>6</sup> See Dabla-Norris and Floerkemeier (2006), Bakradze and Billmeier (2007) and CBN (2007b) who presented thorough discussion of the various channels in the Armenian and Georgian context respectively. It also draws from an ongoing study by Research Department of Central Bank of Nigeria on Monetary Transmission Mechanism.

Source: Obtained from Statistical Bulletin and Annual Reports and Statement of Accounts of Central Bank of Nigeria, various issues.

Fiscal profile of the government declines almost throughout with no serious threat of dominance. Rate of real GDP growth revealed an impressive performance in 2003 and remained stable at around 6 percent afterwards. The ratio of credit to the economy to GDP is moderate. Notice that the above trends revealed only a casual relationship in and between the aggregates. Any definite cause and effect interaction could be best obtained by recourse to more serious econometric analysis. We present the research methodology of the study in the next section.

#### IV. Methodology of the Paper

In this section, we examine one major empirical precondition<sup>7</sup> of inflation targeting regime mentioned above; trying to build a solid understanding of the relationship between monetary policy instruments and inflation rate measured in terms of consumer price index. To achieve the above and in line with the methodology employed by Gottschalk and Moore (2001), Tutar (2002) and, more recently, by Bakradze and Billmeier (2007), this paper adopts vector autoregression (VAR) methodology and the Granger causality tests in both bivariate and multivariate forms. The VAR methodology is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables.

The general mathematical representation of a VAR is:

$$X_t = A(L)X_{t-1} + B(L)Z_t + \varepsilon_t \quad (1)$$

Equation (1) is saying that  $X_t$  is a  $k$  vector of endogenous variable,  $Z_t$  is a  $d$  vector of exogenous variables,  $A$  and  $B$  are matrices of reduced-form coefficients to be estimated, and  $\varepsilon_t$  is a vector of innovations, impulses or shocks. We estimate the reduced-form VAR and identified monetary policy shocks through the liquidity, interest rate and exchange rate channels. The endogenous

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<sup>7</sup> According to Sterne (2004), the inflation targeting experience of industrialized countries suggested that central banks without an established track record for providing durable monetary stability could gain credibility fairly quickly by designing frameworks that provide appropriate incentives for government and the central bank to deliver low inflation. These in turn can help to build a constituency for low inflation that involved a virtuous circle of reducing inflation expectations and strengthening society's confidence in its monetary institutions.

variables in the model consists of the gross domestic product ( $y_t$ ), consumer price index ( $cpi$ ), domestic money supply ( $dms$ ), fiscal spending ( $fs$ ), interest rate ( $ir$ ) and exchange rate ( $er$ )

$$X_t = (y_t, cpi, dms, fs, ir, er)' \quad (2)$$

The ordering of the variables follows the lower diagonal value of a correlation matrix and the degree of endogeneity to current economic conditions and in line with the Cholesky ordering criteria. We use data at quarterly frequency from 1986Q1 to 2007Q4 obtained from the publications of Central Bank of Nigeria and international financial statistics (IFS) from the International Monetary Fund (IMF). The VAR has 5 lags - in line with the information provided by the lag section criteria, no constant or time trend and uses logarithm for all variables except interest rate where we have used the level. We run the VAR in levels in line with the Bayesian methodology, which according to Mountford (2005) the methodology is robust to the presence of non-stationarity and though it does not impose any cointegrating long run relationships between the variables, it does not preclude their existence either.

## V. Empirical Analysis

One of the main prerequisite for a successful adoption of inflation targeting framework as expounded in many empirical studies is the existence of a stable and predictable relationship between monetary policy instruments and inflation. In this section we present the empirical results of our VAR model, which contains six endogenous variables as specified in equation (2). Meanwhile, as a preliminary analysis, the Granger causality tests on some select channels of monetary transmission are presented as follows.

Table 2 presents the results of the bivariate and multivariate block Granger causality tests for price ( $cpi$ ) and output ( $y_t$ ) in Nigeria. The test tests whether an endogenous variable can be treated as exogenous for each equation in the VAR. Overall, the results suggest the joint significance of the policy variables on  $cpi$  and  $y_t$ . The joint probabilities for the multivariate tests suggest the rejection of the null hypothesis. The bivariate tests for  $cpi$  suggest that all the variables except interest rate cause significant variations in  $cpi$ . This is consistent with the expectations; that is, the level of output, money supply, exchange rate and fiscal spending cause variations in the level of prices or the  $cpi$ .

The results further show that two key monetary policy variables; interest rate and money supply, significantly drive output. Government's fiscal spending too, significantly drives output. However, exchange rate and prices are insignificant. The findings support one of the main policy thrust of monetary policy in Nigeria of achieving of price stability and economic growth via monetary policy.

Table 2: Granger Causality Tests: Baseline VAR, 1999–2006 1/

| <b>Effect on price (<i>cpi</i>)</b>            | <b>Chi-square</b> | <b>Probability</b> |
|--|-------------------|--------------------|
| <i>y<sub>t</sub></i>                           | 7.23              | 0.124*             |
| <i>Dms</i>                                     | 8.69              | 0.069*             |
| <i>Er</i>                                      | 8.38              | 0.079*             |
| <i>Fs</i>                                      | 7.60              | 0.108*             |
| <i>Ir</i>                                      | 4.50              | 0.342              |
| <i>Joint</i>                                   | 34.56             | 0.023*             |
| <b>Effect on Output (<i>y<sub>t</sub></i>)</b> |                   |                    |
| <i>Dms</i>                                     | 5.6               | 0.231**            |
| <i>Cpi</i>                                     | 2.97              | 0.562              |
| <i>Er</i>                                      | 4.72              | 0.317              |
| <i>Fs</i>                                      | 7.66              | 0.105*             |
| <i>Ir</i>                                      | 24.92             | 0.000*             |
| <i>Joint</i>                                   | 49.93             | 0.000*             |

Source: Authors' calculations.

1/ The block Granger causality test for exclusion of a variable is based on a Wald test and follows a  $\chi^2$  distribution; \* and \*\* denote rejection of the exclusion at the 1 and 5 percent level.

An intuitive way to interpret the relationship between monetary policy instruments and *cpi* using VAR is to compute an impulse response function (IFR). An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. In our analysis, for instance, if there is a strong and predictable relationship between the monetary policy instruments and future *cpi*, then it can be said that the lagged changes in the monetary policy instruments are economically important in explaining future *cpi*. Throughout, we use a period of 12 quarters ahead in the analysis of impulse response function and the variance decompositions and 95 percent confidence interval, is represented by the dotted lines.

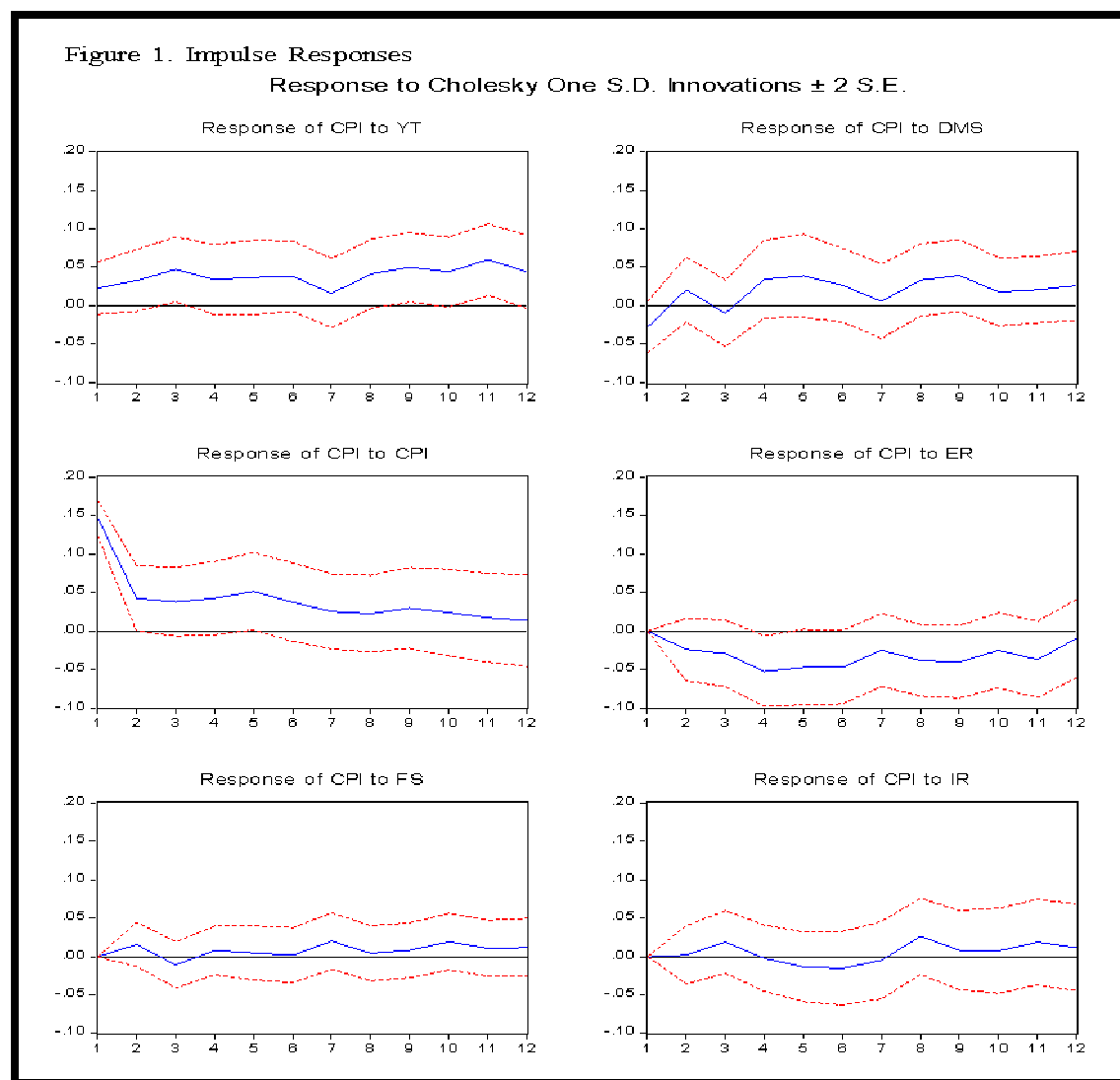
In figure 1 below, the quarterly impulse response functions indicate how the monetary policy and other related variables affect *cpi*. In other words, it shows how *cpi* responds to innovations or shocks in the other endogenous variables as specified in the VAR equation 2. The response of *cpi* to its own shocks is contemporaneously very strong and also in the quarter following the shock and throughout the short and medium term horizons at an average of 4-5 percent, but, less persistent afterwards. Also, a one-standard deviation shock to domestic money supply results in an increase in *cpi* of about 2.1 percent in the quarter following the shock and remains significant in the fourth quarter. This is despite the initial undershooting in the first and third quarter. The response stabilizes at an average of a little above 2 percent in the medium and long term horizons. The response of money supply<sup>8</sup> on the other hand, to innovations in *cpi* is, however, negative at close to 2 percent in the medium term and an average of 2.6 percent in the long term horizon. By way of summing up, while expansionary monetary policy, which works through the liquidity channel, positively affects prices in the economy, inflationary pressure is usually followed by contractionary monetary measures in the economy.

The response of *cpi* to positive innovations in output is, however, counterintuitive, though very strong at average of 3.5 percent in the short and medium term horizons and subsequently up to 5.9 percent somewhere in the long term. This implies that increase in productivity rather than leads to a decline in prices generate more inflationary pressure in the economy. More consistent is the response of output to shocks in *cpi*, which in line with theoretical postulations, shows an inverse link – see appendix for more results.

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<sup>8</sup> See the appendix for a full set of impulse responses results





Furthermore, consistent with theory is the response of *cpi* to innovations in exchange rate, which is very strong, especially in the medium term, it stood at an average of 4 percent. This implies that persistent exchange rate depreciation causes inflation<sup>9</sup>. This finding could be expected because of the reliance of the economy on imported food and other items. This strongly corroborates the above findings in table 2 and hence a pointer to the strength of the exchange rate channel as a means of checking inflation. While a number of studies<sup>10</sup> show that a flexible

<sup>9</sup> The exchange rate-*cpi* link suggests the effect of exchange rate pass-through, that is, the degree by which exchange rate depreciation translate into inflation in the economy.

<sup>10</sup> See Bernanke *et al.* (1999), Mishkin and Savastano (2002) and De Gregorio, Tokman and Valdes (2005). Edward (2006) analyze three key issues in his study: i) the effectiveness of nominal exchange rates as shock absorbers in countries with inflation targeting, which is closely related to the magnitude of the "pass-through" coefficient. ii)

exchange rate regime is consistent with the inflation targeting framework, others, however, show that this could generate more instability when the exchange rate is allowed to float<sup>11</sup>.

The response of *cpi* to fiscal spending is consistent, less severe – at less than 1 percent on the average, and is less persistent over the time horizons. This is contrary to the results in table 2. Finally, the response of *cpi* to interest rate – 3 months deposit rate, is generally weak, counterintuitive and less persistent. So is also the response of interest to price shocks. This supports the result of Granger causality test reported in table 2 and as well suggests that interest rate channel of monetary transmission is weak.

Variance decomposition results presented in table 3 corroborate the above empirical findings from the impulse responses. The 12 period forecast (3 years) show that, put together, the variances of output, money supply, exchange rate fiscal spending and interest rate account for less than 50 percent of variability in *cpi*. In other words, innovations to these endogenous variables explain less 50 percent variation in the level of consumer price index in the short and medium term horizons. This implies that the price behavior is characterized by inertial nature or is apathetical within these time horizons. Therefore, a policy change in either money supply or interest rate is unlikely to bring desired change in price as the two accounted for less than 15 percent (jointly) in the short and medium term. In the long term, however, the trend gradually changes, *cpi* accounts for less than 45 percent of its variance while output and exchange rate gained more prominence. This further underscores the need for an increase in productivity and importance of the exchange rate channel in checking inflation in the economy.

The variance decomposition of output follows suit as it also chiefly drives its own variance in the first quarter. The variance of interest rate forcefully took over in the medium term, accounting for over  $\frac{1}{2}$  of output variability and over  $\frac{1}{3}$  in the long term horizon. This truly reflect our discovery in table 2 where the latter strongly Granger cause the former.

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whether exchange rate volatility is different in countries with an inflation targeting regime than in countries with alternative monetary policy arrangements. iii) whether the exchange rate should play a role in determining the monetary policy stance under inflation targeting.

<sup>11</sup> This connection between inflation targeting and floating exchange rates has led some analysts to argue that one of the costs of IT is the increase in exchange rate volatility. However, recent study by Edward (2007) argues that there is no need for the authorities to abstain completely from intervention in the foreign exchange market.

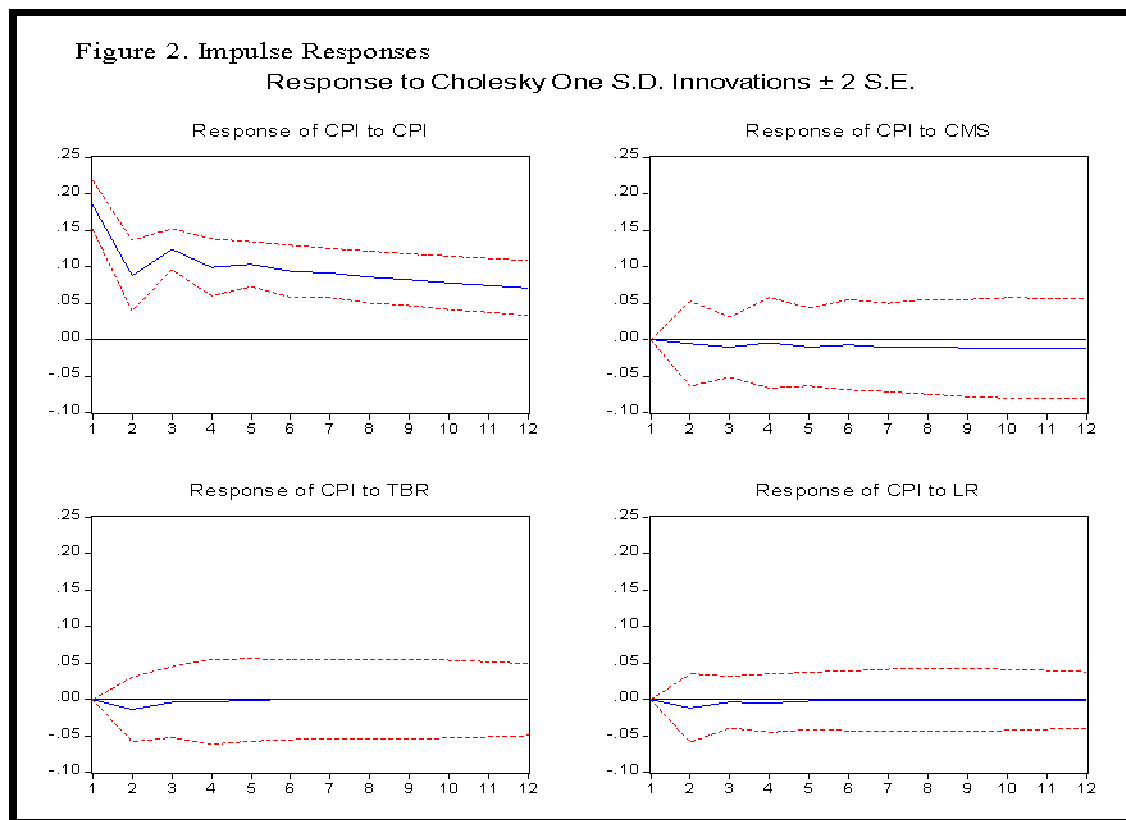
Table 3: Variance Decomposition: VAR, 1986Q1–2006Q4  
(In percent of total variance)

| <b>Variance Decomposition of CPI:</b>     |          |          |          |          |          |          |          |
|---|----------|----------|----------|----------|----------|----------|----------|
| Period                                    | S.E.     | YT       | DMS      | CPI      | ER       | FS       | IR       |
| 1   | 0.040689 | 2.271086 | 3.373526 | 94.35539 | 0.00000  | 0.00000  | 0.00000  |
| 2   | 0.064954 | 5.849749 | 4.436332 | 86.67507 | 2.103144 | 0.917074 | 0.018636 |
| 3   | 0.085957 | 11.78645 | 4.043581 | 77.49763 | 4.39067  | 1.133573 | 1.148097 |
| 4   | 0.111246 | 12.64488 | 6.350427 | 68.40082 | 10.55253 | 1.095392 | 0.955951 |
| 5   | 0.130773 | 13.3771  | 8.448556 | 62.56622 | 13.47103 | 0.961304 | 1.175791 |
| 6   | 0.147241 | 14.59483 | 8.822429 | 58.12611 | 16.12265 | 0.858693 | 1.475293 |
| 7   | 0.162316 | 14.54152 | 8.566143 | 57.21748 | 16.64349 | 1.567233 | 1.46413  |
| 8   | 0.175295 | 16.0195  | 9.607804 | 52.88541 | 17.55521 | 1.45628  | 2.475797 |
| 9   | 0.187228 | 18.12044 | 10.95031 | 48.99512 | 18.18612 | 1.414214 | 2.33379  |
| 10  | 0.197142 | 19.82575 | 10.80463 | 47.14089 | 18.07911 | 1.865403 | 2.284218 |
| 11  | 0.206331 | 22.87934 | 10.50636 | 43.77798 | 18.40055 | 1.870787 | 2.564985 |
| 12  | 0.215415 | 24.39233 | 10.93614 | 42.27761 | 17.78639 | 1.971502 | 2.636035 |
| <b>Variance Decomposition of YT:</b>      |          |          |          |          |          |          |          |
| Period                                    | S.E.     | YT       | DMS      | CPI      | ER       | FS       | IR       |
| 1   | 0.048745 | 100      | 0.00000  | 0.00000  | 0.00000  | 0.00000  | 0.00000  |
| 2   | 0.060003 | 85.48264 | 0.28409  | 1.10365  | 0.007869 | 0.08432  | 13.03743 |
| 3   | 0.069554 | 69.08072 | 0.307109 | 0.762887 | 0.004502 | 0.05994  | 29.78485 |
| 4   | 0.079308 | 53.50970 | 1.589696 | 0.462939 | 0.491839 | 0.121089 | 43.82474 |
| 5   | 0.09543  | 41.74796 | 2.272447 | 0.591329 | 0.930217 | 0.203024 | 54.25502 |
| 6   | 0.105018 | 35.05878 | 3.474235 | 1.366036 | 2.96312  | 0.641015 | 56.49681 |
| 7   | 0.115789 | 31.03246 | 5.267123 | 1.900086 | 6.81929  | 1.365692 | 53.61535 |
| 8   | 0.12747  | 28.88327 | 6.951155 | 2.3792   | 10.58112 | 2.12932  | 49.07594 |
| 9   | 0.139757 | 28.15783 | 8.350472 | 2.796563 | 13.42415 | 3.326445 | 43.94454 |
| 10  | 0.151549 | 28.49554 | 9.53839  | 3.186676 | 14.5649  | 4.513205 | 39.70129 |
| 11  | 0.163469 | 29.67405 | 10.45181 | 3.561651 | 14.37312 | 5.614539 | 36.32482 |
| 12  | 0.174479 | 31.36517 | 10.95398 | 3.848665 | 13.47403 | 6.65031  | 33.70784 |
| Cholesky Ordering: YT DMS CPI ER<br>FS IR |          |          |          |          |          |          |          |

Other variance decompositions<sup>12</sup> of the variables in the VAR model show that money supply drives its own variance in the short term, but, subsequently by variances of output and fiscal

<sup>12</sup> See the appendix for a full set of variance decomposition results

spending. Exchange rate also shapes its own variance in the short term and then by the variance of government's fiscal spending. Earlier, the decomposition of the variance of output shows that the nexus between fiscal spending and output is very weak - the variance of the latter accounts for less than one-tenth of variations in the former throughout the three time horizons; short, medium and long term, this in a feedback effect is confirmed from the decomposition of the variance of fiscal spending. However, contrary expectations and to what in reality obtains, the variance of interest rate accounts for over 60 percent (almost two-third of variation in fiscal spending) in the medium term and more than 50 percent (over one-half of variation in fiscal spending) in the long term. Lastly, in line with our earlier findings, the variance of output drives about one-third of variability in the level of interest rate



The nexus between monetary policy instruments and *cpi* is further explored using additional endogenous variables by the authors. These include; treasury bills rate, lending rate and ratio of credit to money supply. A four-variable VAR is estimated using lag 1 and 2 as suggested by the

lag selection criteria and the ordering of the variables also follows the Cholesky criteria. Figure 2 presents the impulse responses of only *cpi* to innovations in other endogenous variables in the model. Again, the response of *cpi* to its own shocks, except for the initial overshooting is very strong in the quarter following the shock and throughout the short and medium term horizons.

The response of *cpi* to innovations in the other three variables is, however, insignificant even though is theoretically consistent. The ratio of credit to lagged  $M_2$ , for instance, deflates *cpi* in the quarter following the shock by only a-half of a percent. This remains very low in the medium term and a little above 1 percent in the long term horizon. The response of *cpi* to innovations in the Treasury Bills rate (*tbr*) is consistent only within the short term horizon although it is highly marginal also. Counter intuitively, the effect in the medium and long term horizons became positive and remained very low throughout. Lending rate's innovations exert negative effect on *cpi* as expected but also very insignificant. It was 1 percent in the quarter following the shock and less than half of a percent throughout.

Table 4: Variance Decomposition: VAR, 1986Q1–2006Q4  
(In percent of total variance)

| Variance Decompositions of CPI    |          |          |          |          |          |
|-----------------------------------|----------|----------|----------|----------|----------|
| Period                            | S.E.     | CPI      | CMS      | TBR      | LR       |
| 1                                 | 0.184575 | 100      | 0.00000  | 0.00000  | 0.00000  |
| 2                                 | 0.205207 | 99.18363 | 0.075026 | 0.427554 | 0.313793 |
| 3                                 | 0.239953 | 99.17586 | 0.240278 | 0.335178 | 0.248682 |
| 4                                 | 0.25971  | 99.22057 | 0.232488 | 0.299612 | 0.247331 |
| 5                                 | 0.279675 | 99.19027 | 0.333436 | 0.258792 | 0.217504 |
| 6                                 | 0.295027 | 99.20980 | 0.358532 | 0.232560 | 0.199105 |
| 7                                 | 0.309013 | 99.15558 | 0.450295 | 0.212184 | 0.181943 |
| 8                                 | 0.320776 | 99.12210 | 0.511277 | 0.197353 | 0.169269 |
| 9                                 | 0.331298 | 99.05235 | 0.603438 | 0.185408 | 0.158801 |
| 10                                | 0.340474 | 98.99097 | 0.682645 | 0.175850 | 0.150531 |
| 11                                | 0.348694 | 98.91462 | 0.773971 | 0.167742 | 0.143669 |
| 12                                | 0.356001 | 98.84226 | 0.858722 | 0.160928 | 0.138089 |
| Cholesky Ordering: CPI CMS TBR LR |          |          |          |          |          |

Variance decompositions presented in table 4 attest the above findings. The results show that *cpi* uniquely drives its own variance in the short, medium and long term horizons. This unveils the fact that the level of prices or *cpi* in the model is an inertial phenomena; meaning predictions about *cpi* could best be obtained within the *cpi* itself. Over 99 percent of the variance of *cpi* is

explained by the itself in throughout the horizons. This implies that past information on the level of *cpi* is very critical in the determination of future level of *cpi*.

## VI. Conclusions and Recommendations

This paper seeks to explore the applicability of IT in the Nigerian economy based on historical data from 1986 to 2006. Although the three key conditions for IT have been identified in the literature; this paper examines only one, which is the existence of a predictable relationship between monetary policy instruments and inflation (the others being CBN autonomy and transparency and accountability). The authors employed Granger causality tests and an unrestricted VAR methodology with five variables in a 4 lag specification.

The bivariate and multivariate Granger causality tests show that the level of output, money supply, exchange rate and fiscal spending in the economy cause variations in the level of prices or the *cpi* while interest rate does not. Output variations were found to be significantly caused by interest rate, money supply and the level of fiscal spending, while the roles of exchange rate and prices were quite insignificant.

The impulse response functions from the VAR model show that the response of *cpi* to its own shocks is contemporaneously very strong and remain so throughout the short and medium term horizons, but, less persistent afterwards. The response of *cpi* to innovations in money supply (liquidity channel) and interest rate (interest rate channel) were found to be less significant. This was reinforced by results from variance decomposition of the *cpi* where the latter two accounted for less than 15 percent of the variance of the former in both the short and medium term. Similar results were obtained when additional variables – monetary indicators, such as ratio of credit to money supply, treasury bills rate and 3-months lending rate, were used. Interest rate, however, was found to be a strong driver of productivity in the economy. Although these findings do not suggest total ineffectiveness of the monetary channels, it however raise doubt when the monetary authority solely rely on them as instruments for achieving effective inflation targeting regime.

On the other hand, the nexus between *cpi* and exchange rate and *cpi* and productivity were found to be robust in the long term although the latter is counterintuitive. Real sector productivity is

paramount in any fight against inflation. Also, the significance of the exchange rate channel given by the inverse link between *cpi* and exchange rate suggest the effect of exchange rate-pass through on the level of prices in the economy. Productivity along with exchange rate accounted for significant percentage of the variance of *cpi* in both the medium and long term. The results further show no threat of fiscal dominance in the sample.

In view of the above findings, which in conclusion reveal no strong quantitative link between monetary aggregates and prices, the paper recommends that Nigeria should not pursue full fledged inflation targeting rather Nigeria should adopt inflation targeting lite given the enormous advantage of inflation targeting as monetary policy framework.

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